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| GB A 2152895 | GB 1559500 |
| GB A 2133377 | GB 0912499 |
| GB A 2118518 | US 3934707 |

(58) Field of search
B8A
B8E
Selected US specifications from IPC sub-class B65G

# (54) A conveyor system with means to accumulate articles

(57) A conveyor system for conveying articles between two points comprises at least one elongate conveyor (4) for conveying articles, a plurality of elongate support members (9) which extend parallel with said at least one conveyor (4), and an elongate lifting assembly (5) associated with either each conveyor (4) or each support member (9). Each lifting assembly comprises an elongate inflatable bag (7), an elongate base member (6) which supports the said bag (7) along its length and an elongate lifting member (9) located above the said bag (7). In use, when the said bag (7) is inflated the lifting member (9) is raised, thereby raising the said conveyor (4) or the said support member (9) relative to the said support member (9) or the said conveyor (4), respectively, and when the bag (7) is deflated the lifting member (9) is lowered, thereby lowering the said conveyor (4) or the said support member (9) relative to the said support member (9) or the said conveyor (4), respectively. Articles may thus be accumulated or conveyed as desired.

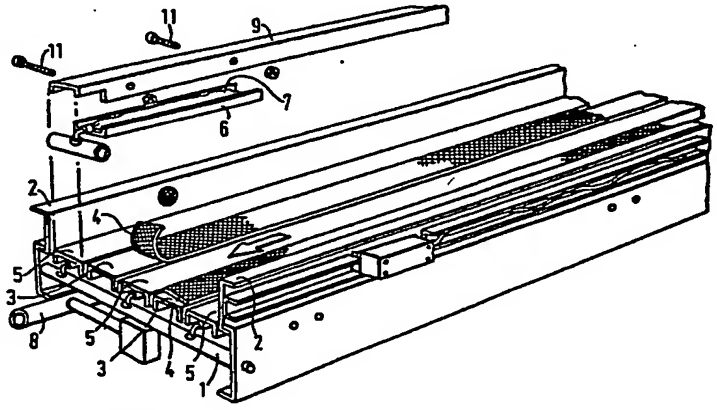


FIG.1

GB 2 187 156 A

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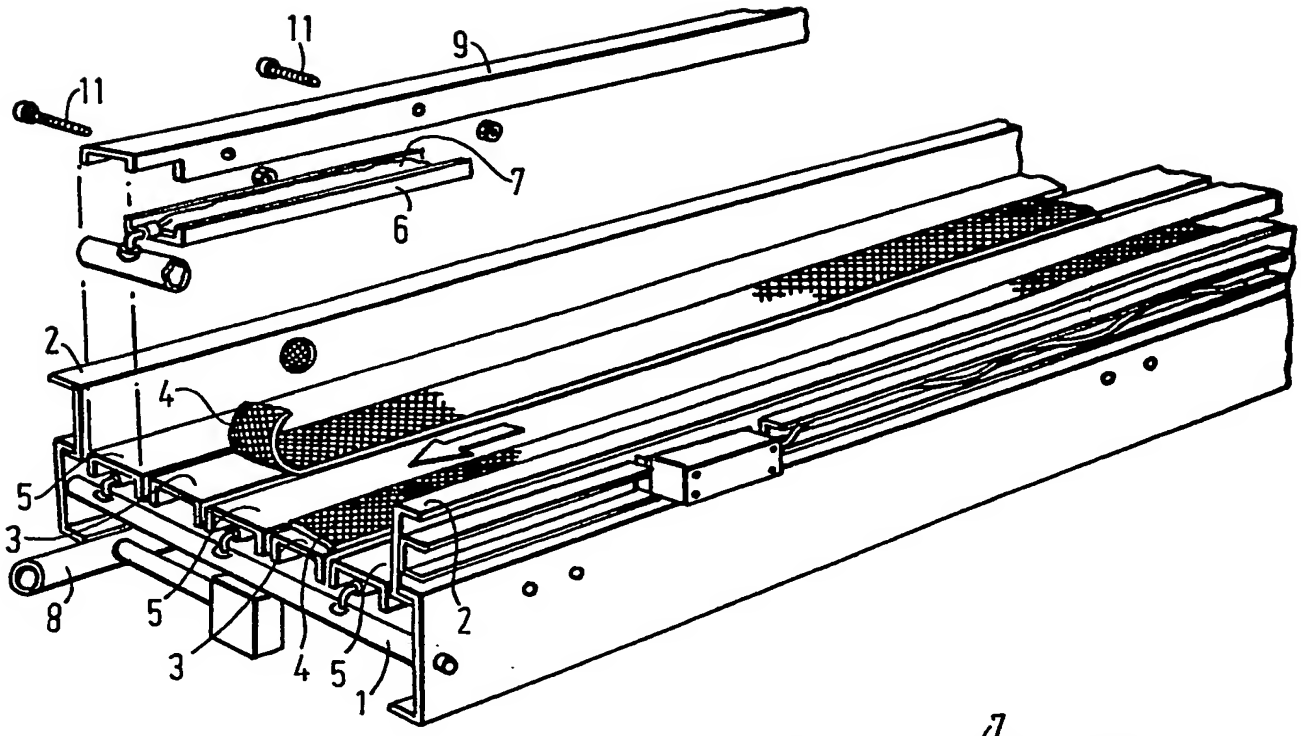


FIG.1

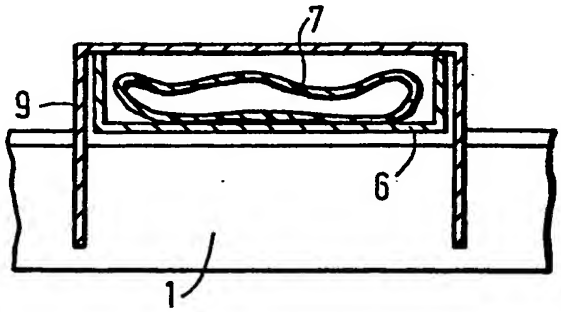


FIG.2

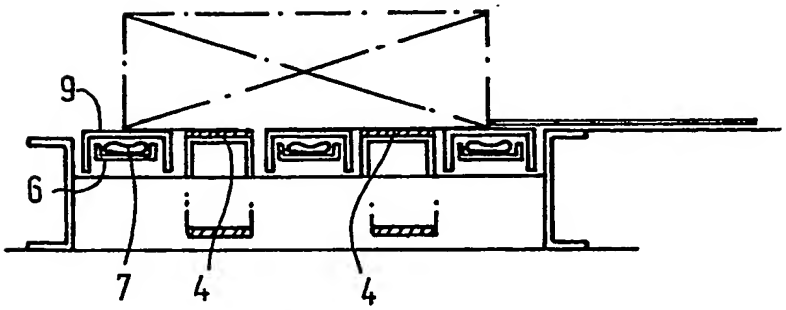


FIG.4

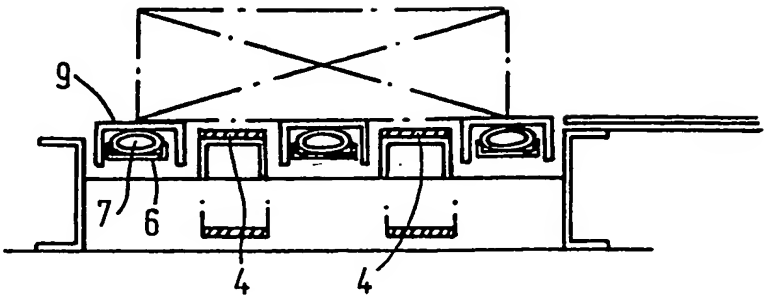


FIG.5

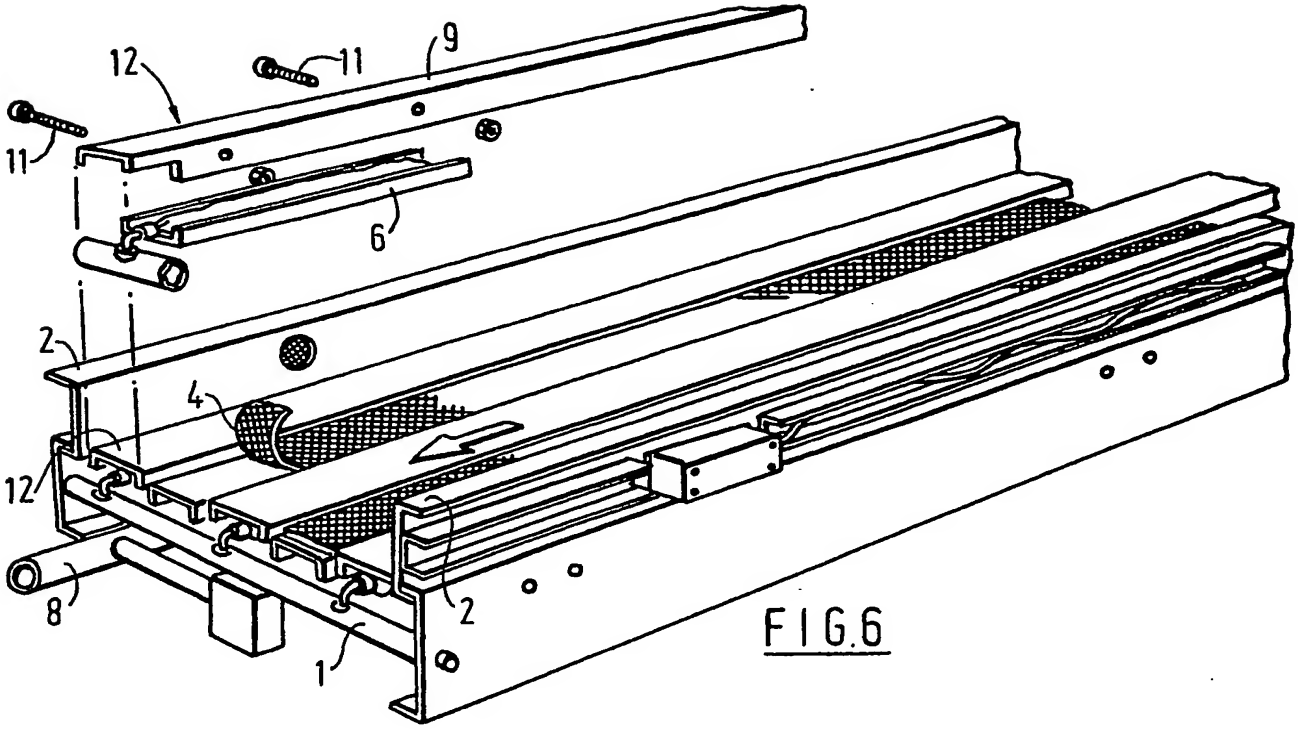


FIG.6

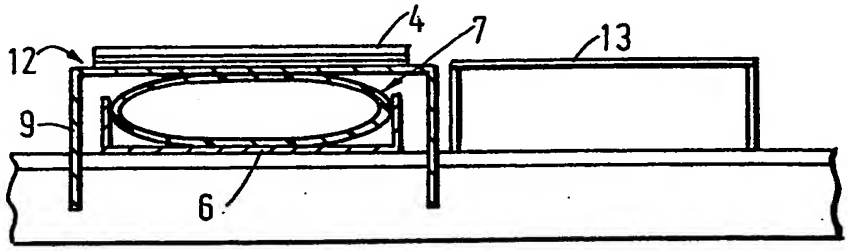


FIG.7

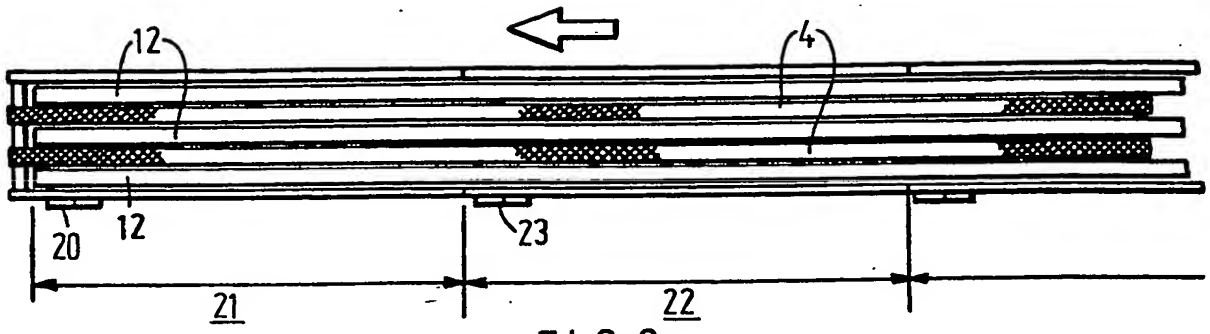


FIG.8

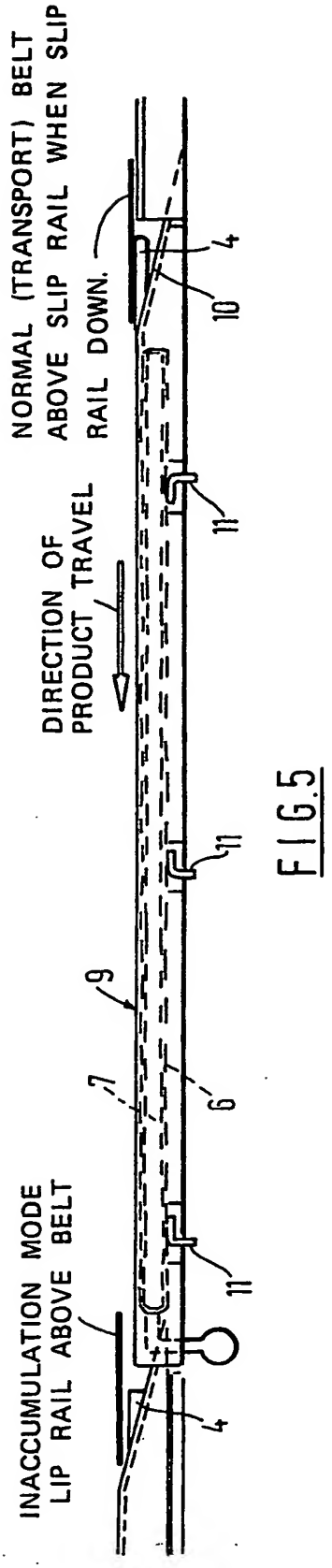
NORMAL (TRANSPORT) BELT ABOVE SLIP RAIL WHEN SLIP RAIL DOWN.
DIRECTION OF PRODUCT TRAVEL
INACCUMULATION MODE LIP RAIL ABOVE BELT
4
10
11
11
9
7
6
11
4

FIG.5

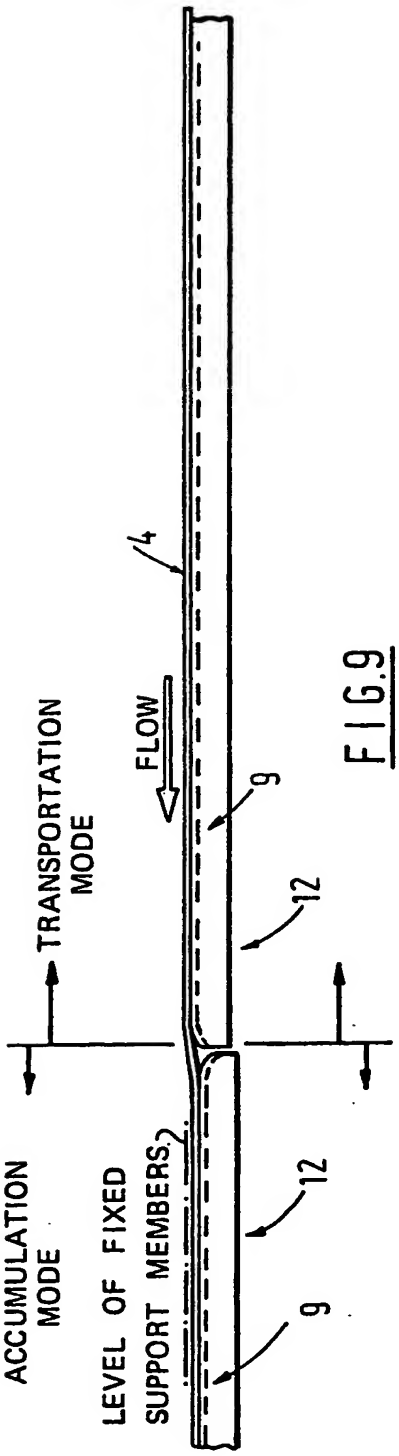
TRANSPORTATION MODE
FLOW
4
9
12
ACCUMULATION MODE
LEVEL OF FIXED SUPPORT MEMBERS
2
12
9

FIG.9

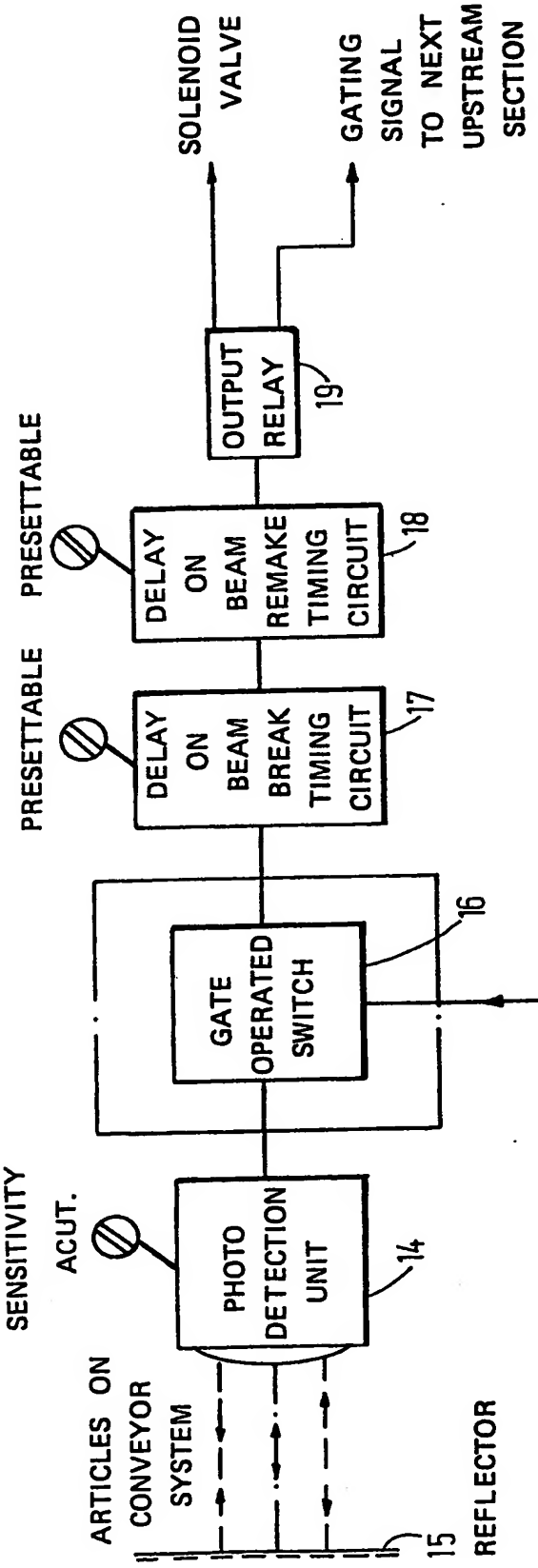
SOLENOID VALVE
GATING SIGNAL TO NEXT UPSTREAM SECTION
OUTPUT RELAY
19
PRESETTABLE
DELAY ON BEAM REMAKE TIMING CIRCUIT
18
PRESETTABLE
DELAY ON BEAM BREAK TIMING CIRCUIT
17
GATE OPERATED SWITCH
16
EXTERNAL GATE INPUT
SENSITIVITY ACUT.
PHOTO DETECTION UNIT
14
ARTICLES ON CONVEYOR SYSTEM
15
REFLECTOR

FIG.10

SPECIFICATION

**A conveyor system**

The present invention relates to a conveyor system for conveying articles between two points, and, in particular, to a conveyor system which allows articles to be stopped and held in an accumulation or holding zone.

Where articles are being conveyed along a conveyor system it is often necessary to temporarily accumulate them in an accumulation or holding zone. This may be necessary for a variety of reasons, for example, to allow a production step to be carried out, to allow quality control procedures to be executed, or to allow articles to be transferred to another conveyor system. Various schemes have been proposed to allow articles to be accumulated, but these have typically required elaborate mechanical drive and control systems to prevent articles from crushing each other or toppling over as they enter the accumulation zone. Generally, these systems are characterised by either stopping sections of the conveyor system as the article or articles to be accumulated enter the accumulation zone, or stopping sections of the conveyor system and allowing the article or articles to coast into the accumulation zone. To work effectively both systems require complex interrelating of the operations of successive accumulation zones to effect an elaborate first in, first out gating of items from one section to the next and the systems must be operated at relatively low speeds.

A conveyor system which makes use of an improved accumulator is disclosed in US Patent No. 3934707, in the name of Rapistan Incorporated. This patent discloses a conveyor system comprising a plurality of elongate lifting members which run alongside the conveyor means and can lift articles above the level of the conveyor means to prevent them being conveyed any further. Each lifting means comprises an elongate U-shaped channel member which receives an elongate inflatable bag, and an elongate inverted U-shaped channel member which is also received within the U-shaped channel member over the top of the inflatable bag. Whilst the inflatable bag is deflated the inverted U-shaped channel lies below the level of the conveyor means and does not interfere with the passage of articles along the conveyor means. However, when the inflatable bag is inflated it lifts the uppermost surface of the inverted U-shaped channel above the level of the conveyor means, thereby disengaging any articles on the conveyor means from the conveyor means and bringing them to a stop.

Unfortunately, this particular conveyor system is prone to allow articles to be caught between the charge end of one conveyor system and the discharge end of the conveyor system immediately preceding it, when these are arranged in tandam with adjacent accumulation zones. Moreover, where articles are moving from a conveyor zone to an accumulation zone articles tend to bump into or hang up on the raised charge end of the lifting means in the accumulation zone.

A further problem associated with the conveyor system of US Patent No. 3934707 is that the lifting means are prone to the ingress of dirt and contaminants. This can give rise to corrosion of the channel members and of the inflatable bag, and can considerably reduce the useful lifetime of the lifting means.

It is an object of the present invention to provide a conveyor system which allows articles to be stopped and held in an accumulation zone which obviates or substantially mitigates the problems associated with conventional conveyor systems referred to hereinabove.

According to a first aspect of the present invention there is provided a conveyor system for conveying articles between two points comprising at least one elongate conveyor for conveying articles, a plurality of elongate support members which extend parallel with said at least one conveyor, and an elongate lifting assembly associated with either each support member, which comprises an elongate inflatable bag, an elongate base member which supports the said bag along its length and an elongate lifting member located above the said bag, whereby, in use, when the said bag is inflated the lifting member is raised, thereby raising the said conveyor or the said support member relative to the said support member or the said conveyor, respectively, and when the bag is deflated the lifting member is lowered, thereby lowering the said conveyor or the said support member relative to the said support member or the said conveyor, respectively.

In a preferred embodiment of the present invention the charge end of each support member defines a preformed ramp whereby articles conveyed along the said at least one conveyor can be driven up the ramp onto the said support surface when the said support members are raised relative to the said at least one conveyor.

It will be appreciated that the provision of a preformed ramp at the charge end of each support member allows articles arriving at the charge end of the conveyor to be driven up onto the support surfaces by the said at least one conveyor with the minimum of effort and thus minimises the risk of articles being caught at the charge end.

Articles which have passed beyond the preformed ramp are pushed along the support surface of the support member by articles being driven up the ramp behind. To facilitate movement of the articles over the support surface if may be coated with or comprised of a low friction material, such as Teflon (a Registered Trade Mark) or a plastics material.

Preferably, the elongate base member comprises a first elongate U-shaped channel and the elongate lifting member comprises a second elongate U-shaped channel which is adapted to receive the said first elongate U-shaped channel between its sides thereby defining a cavity therebetween within which the elongate inflatable bag is received. This arrangement, where the upper channel covers the lower channel and recieves it between its sides, ensures that dirt and contaminents do not enter the cavity defined therebetween from the said at least one conveyor and the articles carried thereon.

Preferably, the sides of the said elongate U-shaped channel extend beyond those of the first and retaining bars extend between the extended sides so as to limit upward movement of the elongate lifting member and prevent it from rolling on the inflated inflatable bag.

In a further preferred embodiment of the present invention each conveyor is supported over its length by the lifting member of a lifting assembly and the ends of each lifting member are chamferred to prevent them from chaffing the conveyor when raised. In this embodiment the support members are fixed and it is the said at least one conveyor which is raised or lowered by the lifting assembly to convey articles or accumulate them on the support members.

When the said at least one conveyor is very long it may be convenient to provide a plurality of lifting assemblies between the ends of each conveyor thereby allowing sections of the conveyor to be selectively raised to convey articles or lowered to allow articles to accumulate on the support members.

It will be appreciated that as articles arrive at the charge end of a conveying system in its accumulation mode from a conveying system in its conveying mode they will have to drop down from the raised conveyors onto the support members. To avoid the possibility of the articles toppling over as they do this the distance between the top of the raised conveyor and the support surfaces of the support members is kept to a minimum.

Preferably, at least two conveyors are provided and support members are provided between each adjacent pair of conveyors and along the outside edge of each outermost conveyor.

Preferably, a control system is provided comprising article detector means located upstream of said at least one conveyor, a timing circuit for detecting the period of time an article takes to pass the article detector means and control means operating the lifting assemblies to lower the said at least one conveyor relative to the support members, thereby putting the conveyor system into its accumulation mode.

According to a second aspect of the present invention there is provided a conveyor system for conveying articles between two points comprising at least one elongate conveyor for conveying articles, a plurality of elongate support members which extend parallel with said at least one conveyor and each comprising a substantially flat support surface and a preformed ramp at the charge end thereof, and an elongate lifting assembly associated with each support member whereby, in use, the support member can be raised or lowered relative to the said at least one conveyor to allow articles to accumulate on the support members or be conveyed by the conveyor, respectively.

According to a second aspect of the present invention there is provided a conveyor system for conveying articles between two points comprising at least one elongate conveyor for conveying articles, a plurality of elongate support members which extend parallel with said at least one conveyor and an elongate lifting assembly associated with each conveyor whereby, in use, the conveyor can be raised or lowered relative to the said support members to allow articles to be conveyed by the conveyor or accumulate on the support members, respectively.

An embodiment of the present invention will now be described, by way of example with reference to the accompanying drawings: in which,

*Figure 1* shows a partially exploded view of a conveyor system in accordance with a first aspect of the present invention;

*Figure 2* shows a section through the lifting mechanism of the conveyor system of Figure 1;

*Figure 3* shows an end view of the conveyor system of Figure 1 in its transportation mode;

*Figure 4* shows an end view of the conveyor system of Figure 1 in its accumulation mode;

*Figure 5* shows a side view of one of the lifting mechanisms of the conveyor system of Figure 1;

*Figure 6* shows a partially exploded view of the discharge end of a conveyor system in accordance with a second aspect of the present invention;

*Figure 7* shows a section through the endless belt lifting mechanism of the conveyor system of Figure 1.

*Figure 8* shows a plan view of the conveyor system of Figure 6 extended towards the charge end thereof;

*Figure 9* shows a side view of the endless belt and endless belt lifting mechanisms from the conveyor system shown in Figure 8; and,

*Figure 10* shows a block schematic diagram of a control system for a conveyor system according to the present invention.

Referring to Figure 1 of the accompanying drawings there is shown a partially exploded view of the discharge end of a conveyor system comprising a support member 1 which is bordered along each side by a guide rail 2. Between the guide rails 2 the support member 1 supports two belt channels 3, in each of which runs an endless conveyor belt 4. The endless belts 4 are driven by drive means (not shown) in conventional fashion and are arranged in spaced relationship along the support member 1 from each other and from the guide rails 2. Within the spaces between the endless belts 4, and between each endless belt 4 and the guide rail 2 adjacent thereto, a lifting assembly 5 is provided.

Referring now to Figure 2 in association with Figure 1, each lifting assembly 5 runs the length of the conveyor belts 4 and comprises an upwardly facing elongate U-shaped channel 6 in which is received a flat, elongate inflatable bag 7. Each bag 7 is closed at one end and is connected at the other end to a common manifold 8 which allows it to be selectively inflated and deflated. Overlying each inflatable bag 7 and the U-shaped channel 6 in which it lies is an elongate inverted U-shaped channel 9. The end of each inverted U-shaped channel 9 adjacent the charge end of the conveyor system (see Figure 5), is provided with a preformed ramp 10. The uppermost surface of the inverted U-shaped channel 9 is coated with, or is comprised of, a low friction material, such as Teflon (a Registered Trade Mark), or a plastics material, and as such it is possible for

articles to slide easily over its surface. Between the sides of the inverted U-shaped channel 9, below the U-shaped channel 6, are fitted two or more cross bars 11 which are provided to restrict upward movement of the inverted U-shaped channel relative to the U-shaped channel 6.

Referring to Figures 3 to 5 of the accompanying drawings, operation of the conveyor system embodying the present invention will now be described. In use, when the inflatable bags 7 are deflated (as shown in Figure 3) the uppermost surface of each inverted U-shaped channel 9 lies below the uppermost surfaces of the endless belts 4 and any articles on that section of the conveyor system will be transported by the endless belts 4 from the charge end of the conveyor system towards the discharge end thereof (as shown in Figure 5). However, when the inflatable bags 7 are inflated (as shown in Figure 4) this raises the uppermost surface of each inverted U-shaped channel 9 above the uppermost surface of the endless belts 4, lifting any articles immediately above from the endless belts 4 and bringing them almost immediately to a stop. The distance that the each inverted U-shaped channel 9 can rise on the inflatable bag 7 is limited by cross bars 11.

The preformed ramp 10 at the charge end of each lifting mechanism 5 ensures that the endless belts 4 drive articles arriving at the charge end of the conveyor system up onto the uppermost surfaces of the inverted U-shaped channels 9. As successive articles encounter the preformed ramps 10 and are driven up them by the endless belts 4 they will tend to drive any articles already on the uppermost surfaces of the inverted U-shaped channel 9, over the low friction surface, towards the discharge end. Articles arriving at the conveyor system will accumulate on the raised uppermost surfaces of the inverted U-shaped channels 9 until the inflatable bag 7 is deflated, dropping the articles down onto the endless belts 4 which can then convey them away.

Referring now to Figures 6 to 10 of the accompanying drawings there is shown an alternative conveyor system to that shown in Figures 1 to 5, although those features which are common to both conveyor systems have been given the same reference numerals.

The conveyor system comprises two endless belts 4 which are each supported on a plurality of conveyor lifting assemblies 12, laid end to end (see Figure 9). Each lifting assembly 12 comprises an upwardly facing elongate U-shaped channel 6 in which is received a flat elongate inflatable bag 7 which is closed at one end and is connected at the other end to a common manifold 8 which allows it to be inflated and deflated. Overlying the bag 7 and the U-shaped channel 6 in which it lies is an elongate inverted U-shaped channel 9 which supports the uppermost run of a respective one of the endless belts 4. Along each side of the endless belts 4, are a plurality of fixed support members 13, the uppermost surfaces of which are coated with, or comprised of, a low friction material. In fact the fixed support members 13 can be continuous over the length of the accumulation conveyor, but normally, this is an impractical proposition, due to the length of most accumulation conveyors.

In use, when a bag 7 is inflated the inverted U-shaped channel 9 and the section of endless belt 4 immediately above is raised above the uppermost surfaces of the fixed support members 13 to either side, as shown in Figure 9 by the section of conveyor system in "transportation" mode. Thus, articles are conveyed the length of the raised sections of endless belt 4. However, when a bag 7 is deflated the inverted U-shaped channel 9 and the section of endless belt 4 immediately above drop below the level of the uppermost surfaces of the support members 13 to either side, as shown in Figure 9 by the section of conveyor system in "accumulate" mode. Articles are lowered onto the support members 13 and disengaged from the endless belts 4 and come to a stop. Where articles arrive at a section of belt 4 in its accumulation mode from a section of belt 4 in its transportation mode they will drop from raised sections of belt 4 onto the support members 13 and will tend to be pushed over the low friction surface of the support members 13 as further articles arrive behind them.

As can be seen in Figure 9 the ends of each inverted U-shaped channel 9 are chamferred to prevent the endless belt 4 from chaffing on them when in the raised position.

Referring now to Figure 10 of the accompanying drawings there is shown a schematic block diagram of a control system for a conveyor system according to both the first and second aspects of the present invention. The control system relies on a photo detection circuit 14 to detect the passage of articles along the conveyor system, in that each article which passes the photo detection circuit breaks a beam of light reflected from a reflector 15 positioned on the opposite side of the conveyor system from the photo detection circuit 14. The output of the photo detection circuit 14 is connected to a gate operated switch 16 which is controlled by an external gate signal which will normally be provided by the control system of the next conveyor system downstream or, where the conveyor system is the last in line by a specially generated signal. The gate operated switch 16 connects the output of the photo detection circuit 14 to a pair of timing circuits 17 and 18, one of which 17 determines the time delay on the detected light beam being broken and the other one of which 18 determines the time delay on the detected light beam being made. The output of the two timers 17 and 18 is connected to an output relay 19 which in turn is connected to a solenoid valve which controls the operation of the conveyor system to engage or disengage articles on the conveyor system with the endless belts.

In operation, once the conveyor system immediately downstream goes into its accumulation mode a signal is passed to the control system turning the gate operated switch 16 on. Once an article is detected by the photo detection circuit as being present for longer than the preset time determined by the beam break timing circuit 17 then the output relay 19 is switched and the solenoid valve is powered up to operate the conveyor system

to disengage the belts from the articles. Thus the conveyor system goes into its accumulation mode. At the same time a gating signal is provided to the conveyor system immediately upstream and the operational steps are repeated.

When the gating signal is removed by the downstream source, as a result of articles being conveyed again the gate operated switch 16 turns off, disconnecting the photo detection circuit 14 from the timer circuits 17 and 18 and the timer 18 is caused to operate, switching the output relay 19 after a preset time interval to power up the solenoid to operate the conveyor system to engage the belts with the articles. At the same time the gating signal to the control system of the conveyor system immediately upstream is removed and the operational steps are repeated for that conveyor system.

Operation of the controly system to progressively accumulate articles on a conveyor system can best be seen in relation to Figure 8. Photo detection circuit 20 is activated as soon as an article interrupts its beam, and through the operation of the control system associated with that circuit 20 the sections of belt in that accumulation zone 21 are disengaged from the articles, in zone 21 bringing them to a stop. Articles in zone 22 push through a short distance into zone 21, until photo detection circuit 23 is operated, after a time delay determined by the beam break time delay circuit, to switch zone 22 into its accumulation mode.

This operation eventually "daisy chains" along the length of the whole conveyor system so that it is all in the accumulation mode.

When it is desired to convey articles away each zone, beginning with zone 21, is switched back to transportation mode by the control system.

CLAIMS

1. A conveyor system for conveying articles between two points comprising at least one elongate conveyor for conveying articles, a plurality of elongate support members which extend parallel with said at least one conveyor, and an elongate lifting assembly associated with either each conveyor or each support member, which comprises an elongate inflatable bag, an elongate base member which supports the said bag along its length and an elongate lifting member located above the said bag, whereby, in use, when the said bag is inflated the lifting member is raised, thereby raising the said conveyor or the said support member relative to the said support member or the said conveyor, respectively, and when the bag is deflated the lifting member is lowered, thereby lowering the said conveyor or the said support member relative to the said support member or the said conveyor, respectively.

2. A conveyor system according to Claim 1, wherein the elongate base member comprises a first elongate U-shaped channel and the elongate lifting member comprises a second elongate U-shaped channel which is adapted to receive the said first elongate U-shaped channel between its sides thereby defining a cavity therebetween within which the elongate inflatable bag is received.

3. A conveyor system according to Claim 2, wherein the sides of the said elongate U-shaped channel extend beyond those of the first and retaining bars extend between the extended sides so as to limit upward movement of the elongate lifting member and prevent it from rolling on the inflated inflatable bag.

4. A conveyor system according to Claim 1, 2 or 3, wherein each conveyor comprises an endless conveyor belt.

5. A conveyor system according to any preceding Claim, wherein the support surface of each support member is coated with or is comprised of a low friction material.

6. A conveyor system according to Claim 5, wherein said low friction material is a plastics material.

7. A conveyor system according to any preceding Claim, wherein the charge end of each support member defines a preformed ramp whereby articles conveyed along the said at least one conveyor can be driven up the ramp onto the said support surface when the said support members are raised relative to the said at least one conveyor.

8. A conveyor system according to any preceding Claim, wherein each conveyor is supported over its length by the lifting member of a lifting assembly and the ends of each lifting member are chamferred to prevent them from chaffing the conveyor when raised.

9. A conveyor system according to Claim 8, wherein a plurality of lifting assemblies are provided between the ends of the conveyor thereby allowing sections of the conveyor to be selectively raised to convey articles or lowered to allow articles to accumulate on the support members.

10. A conveyor system according to any preceding Claim, wherein at least two conveyors are provided and support members are provided between each adjacent pair of conveyors and along the outside edge of each outermost conveyor.

11. A conveyor system according to any preceding Claim, wherein a control system is provided comprising article detector means located upstream of said at least one conveyor, a timing circuit for detecting the period of time an article takes to pass the article detector means and control means operating the lifting assemblies to lower the said at least one conveyor relative to the support members, thereby putting the conveyor system into its accumulation mode.

12. A conveyor system for conveying articles between two points comprising at least one conveyor for conveying articles, a plurality of elongate support members which extend parallel with said at least one conveyor and each comprising a substantially flat support surface and a preformed ramp at the charge end thereof, and an elongate lifting assembly associated with each support member whereby, in use, the support member can be raised or lowered relative to the said at least one conveyor to allow articles to accumulate on the support members or be conveyed by the conveyor,

respectively.

13. A conveyor system for conveying articles between two points comprising at least one elongate conveyor for conveying articles, a plurality of elongate support members which extend parallel with said at least one conveyor and an elongate lifting assembly associated with each conveyor whereby, in use, the conveyor can be raised or lowered relative to the said support members to allow articles to be conveyed by the conveyor or accumulate on the support members, respectively.

14. A conveyor system substantially as hereinbefore described with reference to the accompanying drawings.

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